

IN THE CLAIMS

The following claim set replaces all prior versions, and listings, of claims in the application:

1. (Currently Amended) A gel polymer electrolyte for rechargeable batteries comprising:

- (i) a gel polymer which is the reaction product of (A) a heterocyclic an amine-group containing material, and (B) a halide-group or epoxy-group containing material, and
- (ii) a liquid electrolyte which contains an amount of an ionic salt effective to achieve ionic conductivity of about 1×10^{-2} S/cm or less.

2. (Canceled)

3. (Currently Amended) The gel polymer electrolyte as in claim 2 1, wherein the halide-group containing material includes at least one halide group selected from chlorides, bromides and iodides.

4. (Currently Amended) The gel polymer electrolyte as in claim 2 1, wherein the epoxy-group containing material includes at least one monomer, oligomer or polymer having at least one epoxy unit.

5. (Original) The gel polymer electrolyte as in claim 1, wherein the ionic salt is a lithium salt.

6. (Currently Amended) The gel polymer electrolyte as in claim 5, wherein the lithium salt is at least one selected from the group consisting of LiPF₆, LiAsF₆, LiClO₄, LiN(CF₃SO₂)₂, LiBF₄, LiCF₃SO₃ and LiSbF₆.

7. (Currently Amended) The gel polymer electrolyte as in claim 1, wherein the ionic salt is present in an amount effective to achieve an ionic conductivity of between about 1×10^{-3} to about 1×10^{-2} S/cm.

8. (Currently Amended) The gel polymer as in claim 1, wherein the heterocyclic amine group ~~nitrogen-group~~ containing material (A) includes at least one secondary or tertiary amine ~~selected from~~ polymers, copolymers, oligomers and monomers each containing one member selected from the group consisting of 6- membered aromatic heterocycles, 5-membered fused aromatic heterocycles and aromatic ~~or non-aromatic~~ tertiary amine compounds.

9. (Currently Amended) The gel polymer electrolyte as in claim 8, wherein the heterocyclic amine group containing material (A) includes at least one heterocyclic amine group containing compound selected from the group consisting of pyridines, pyridazines, pyrimidines, pyrazines, triazines, triazoles, thiazoles, and thiadiazoles ~~and compounds containing five or more carbon atoms in addition to at least one nitrogen atom.~~

10. (Currently Amended) The gel polymer electrolyte as in claim 1 or 9, wherein material (B) includes an epoxy-group containing material and/or material (B) includes an epoxy-group containing material and/or a an aromatic or non-aromatic halide material an aromatic or non-aromatic halide material.

11. (Currently Amended) The gel polymer electrolyte as in claim 10, wherein the material (B) is an aromatic halide selected from polymers, copolymers or monomers containing halomethyl benzene, halomethyl naphthalene, halomethyl biphenyl, bis(halomethyl) benzene, bis(halomethyl) naphthalene, bis(halomethyl) biphenyl, tris(halomethyl) benzene, tris(halomethyl) naphthalene, tris(halomethyl) biphenyl, tetrakis(halomethyl) benzene, tetrakis(halomethyl) naphthalene, tetrakis(halomethyl) biphenyl, halomethylstyrene.

12. (Currently Amended) The gel polymer electrolyte of claim 11, wherein the halomethyl of the aromatic halide is chloromethyl, bromomethyl or iodomethyl.

13. (Currently Amended) The gel polymer electrolyte of claim 10, wherein the material (B) is a non-aromatic halide selected from C2 or greater alkanes which include diiodo, triodo or tetraiodo groups.

14. (Currently Amended) The gel polymer electrolyte as in claim 10, wherein material (B) is an epoxy-group containing material which is at least one selected from the group consisting of 3,4-epoxycyclohexylmethyl-3',4'-epoxycyclohexane carboxylate, glycidyl dodecafluoroheptylether, polypropylene glycol diglycidyl ether, glycidyl dodecafluoroheptylether, butadiene diepoxide, butanediol diglycidyl ether, cyclo hexene oxide, cyclopentene oxide, diepoxy cyclooctane, ethylene glycol diglycidyl ether and 1,2-epoxy hexane.

15. (Currently Amended) The gel polymer electrolyte of claim 1, wherein the gel polymer is present, based on the total weight of the gel polymer electrolyte, in an amount between about 1 wt.% to about 30 wt.%.

16. (Currently Amended) The gel polymer electrolyte of claim 1 or 15, wherein the liquid electrolyte is present, based on the total weight of the gel polymer electrolyte, in an amount between about 30 wt.% to about 99 wt.%.

17. (Currently Amended) The gel polymer electrolyte of claim 1, wherein the liquid electrolyte is present, based on the total weight of the gel polymer electrolyte, in an amount of about 95 wt.% or greater.

18. (Currently Amended) A gellable electrolyte for a rechargeable battery comprising (i) a liquid gelling agent mixture of (A) a heterocyclic an amine-group containing material, (B) a halide-group or epoxy-group containing material, and (ii) a

liquid electrolyte which contains an amount of an ionic salt effective to achieve ionic conductivity of about 1×10^{-2} S/cm or less.

19. (Original) The gellable electrolyte as in claim 18, wherein the halide-group containing material includes at least one halide group selected from chlorides, bromides and iodides.

20. (Original) The gellable electrolyte as in claim 18, wherein the epoxy-group containing material includes at least one monomer, oligomer or polymer having at least one epoxy unit.

21. (Original) The gellable electrolyte as in claim 18, wherein the ionic salt is a lithium salt.

22. (Original) The gellable electrolyte as in claim 21, wherein the lithium salt is at least one selected from the group consisting of LiPF₆, LiAsF₆, LiClO₄, LiN(CF₃SO₂)₂, LiBF₄, LiCF₃SO₃ and LiSbF₆.

23. (Original) The gellable electrolyte as in claim 18, wherein the ionic salt is present in an amount effective to achieve an ionic conductivity of between about 1×10^{-3} to about 1×10^{-2} S/cm.

24. (Currently Amended) The gellable electrolyte as in claim 18, wherein the heterocyclic amine group ~~nitrogen-group~~ containing material (A) includes at least one secondary or tertiary amine ~~selected from~~ polymers, copolymers, oligomers and monomers each containing one member selected from the group consisting of 6-membered aromatic heterocycles, 5-membered fused aromatic heterocycles and aromatic or non-aromatic tertiary amine compounds.

25. (Currently Amended) The gellable electrolyte as in claim 24, wherein wherein the heterocyclic amine group containing material (A) includes at least one heterocyclic

amine group containing compound selected from the group consisting of pyridines, pyridazines, pyrimidines, pyrazines, triazines, triazoles, thiazoles, and thiadiazoles and ~~compounds containing five or more carbon atoms in addition to at least one nitrogen atom.~~

26. (Original) The gellable electrolyte as in claim 18 or 25, wherein material (B) includes an epoxy-group containing material and/or an aromatic or non-aromatic halide material.

27. (Original) The gellable electrolyte as in claim 26, wherein the material (B) is an aromatic halide selected from polymers, copolymers or monomers containing halomethyl benzene, halomethyl naphthalene, halomethyl biphenyl, bis(halomethyl) benzene, bis(halomethyl) naphthalene, bis(halomethyl) biphenyl, tris(halomethyl) benzene, tris(halomethyl) naphthalene, tris(halomethyl) biphenyl, tetrakis(halomethyl) benzene, tetrakis(halomethyl) naphthalene, tetrakis(halomethyl) biphenyl, halomethylstyrene.

28. (Original) The gellable electrolyte of claim 27, wherein the halomethyl of the aromatic halide is chloromethyl, bromomethyl or iodomethyl.

29. (Currently Amended) The ~~gel-polymer~~ gellable electrolyte of claim 26, wherein the material (B) is a non-aromatic halide selected from C2 or greater alkanes which include diiodo, triiodo or tetraiodo groups.

30. (Currently Amended) The ~~gel-polymer~~ gellable electrolyte as in claim 26, wherein material (B) is an epoxy-group containing material which is at least one selected from the group consisting of 3,4-epoxycyclohexylmethyl-3',4'-epoxycyclohexane carboxylate, glycidyl dodecafluoroheptylether, polypropylene glycol diglycidyl ether, glycidyl dodecafluoroheptylether, butadiene diepoxide, butanediol diglycidyl ether, cyclo hexene oxide, cyclopentene oxide, diepoxy cyclooctane, ethylene glycol diglycidyl ether and 1,2-epoxy hexane.

31. (Currently Amended) The gellable electrolyte of claim 18, wherein the gelling agent is present, based on the total weight of the gellable electrolyte, in an amount between about 1 wt.% to about 30 wt.%.

32. (Currently Amended) The gellable electrolyte of claim 18 or 31, wherein the liquid electrolyte is present, based on the total weight of the gellable electrolyte, in an amount between about 30 wt.% to about 99 wt.%.

33. (Currently Amended) The gellable electrolyte of claim 18, wherein the liquid electrolyte is present, based on the total weight of the gellable electrolyte, in an amount of about 95 wt.% or greater.

34. (Original) The gellable electrolyte of claim 33, wherein the ionic salt is present in an amount between about 0.5M to 2.0M.

35. (Currently Amended) A rechargeable battery comprising an anode, a cathode, a microporous separator separating said anode and said cathode, and a gel polymer electrolyte according to any one of claims 1 and 3-9.

36. (Original) The rechargeable battery of claim 35 which exhibits a pre-charge voltage of at least about 0.3 V or greater.

37-61 (Canceled)


62. (New) A gel polymer electrolyte for rechargeable batteries comprising:

- (i) a gel polymer which is the reaction product of (A) a vinylpyridine compound, and (B) an epoxy-group containing material, and
- (ii) a liquid electrolyte which contains an amount of an ionic salt effective to achieve ionic conductivity of about 1×10^{-2} S/cm or less.

Chi-Kyun PARK et al

Serial No. 09/986,459

June 12, 2003



63. (New) The gel polymer electrolyte as in claim 62, wherein the vinylpyridine compound (A) is poly(2-vinyl-pyridine-co-styrene), and the epoxy-group containing material is butanediol diglycidyl ether.

64. (New) A rechargeable battery comprising an anode, a cathode, a microporous separator separating said anode and said cathode, and a gel polymer electrolyte according to claim 62 or 63.
